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Gottlieb Binder GmbH & Co. KG
Bahnhofstrasse 19, 71088 Holzgerlingen

Display Device

The invention relates to a display device with a plurality of pixels for display of static and motion pictures, alphanumeric characters or the like, the pixels being triggerable by means of trigger electronics individually or in groups, and the display device having a first flat substrate.

These display devices are common for example in the area of entertainment electronics or information technology. The technology most frequently used at present is based on liquid crystals which can be used in a triggerable manner as light valves and for example are used as so-called LCDs (liquid crystal displays) in computer monitors, TV and video display equipment, information boards and the like. Alternative technologies for implementing the pixels are for example plasma technology or the use of light emitting diode arrays of inorganic semiconductors.

The known display devices are installed in a housing which is also used to protect the display device. If the housing is made as a desktop housing, it has the corresponding mechanical stability. In the case of wall mounting, as is of interest for example in entertainment electronics, complex mounting devices are necessary.

US 4,602,191 discloses an article of clothing with openings in its cover fabric, through which light emitting diodes can be inserted from the back. The light emitting diodes are connected to a flexible circuit board. On the side on which the light emitting diodes project away from the circuit board, on the circuit board an adhesion closure part is fastened which has a plurality of adhesion closure elements. The adhesion closure elements protrude from the adhesion closure part

in the direction of the light emitting diodes and are intended for engagement with hook-shaped adhesion closure elements of a second adhesion closure part which is located on the inside of the article of clothing.

DE 202 15 401 U1 shows a combination of a thin substrate and a carrier substrate by cementing, by adhesion forces, by electrostatic forces or by a vacuum.

WO 02/35672 A2 shows an electrical cable with adhesion closure elements on its surface to fix the cable with them on a carrier surface.

JP 2003-115388 A and JP 2003-051383 A show laminar structures for producing organic light emitting diodes, so called OLEDs.

The object of the invention is to make available a display device which overcomes the disadvantages of the prior art, especially simplifies attachment and thus also increase the functionality and possible applications of these display devices. Attachment should be simple and preferably possible without tools. The fasteners should be easy and economical to produce and ensure permanently reliable attachment.

The object is achieved by the display device defined in claim 1. Special embodiments of the invention are defined in the dependent claims.

As claimed in the invention the display device has a first flat substrate, from the first surface of which at least in areas adhesion closure elements project for detachably fixing the display device to a carrier means. The attachment forces can be formed by mechanical interlocking and/or by chemical binding forces. Mechanical interlocking can be achieved for example with adhesion closure elements which are produced by a shaping process with integral execution of the adhesion

closure elements together with a flat support, as is described for example in DE 196 46 318 A1. The adhesion closure elements can be hook-shaped, mushroom-shaped, loop-shaped or can have other corresponding interlocking means. The adhesion closure elements of the first flat substrate can be formed for example from a hook, mushrooms, loops, pile or the like and can interact with the corresponding adhesion closure elements of the carrier means, and the adhesion closure elements of the flat substrate and of the carrier means can be made identical or complementary, for example hook-hook, mushroom-mushroom, hook-loop or mushroom-loop connections being possible.

Alternatively or in addition, the adhesion closure elements of the first flat substrate can interact with a surface of the carrier means also by chemical bonding forces, interact especially by means of van der Waals forces or dipole forces. To do this, for example stems made integrally with the flat substrate on their free end can be divided into a plurality of individual fibers, for example into several hundred fibers per stem, a typical diameter of such a fiber being less than 2 μm, preferably less than 1 μm and typically roughly 0.2 μm. The length of the individual fibers is preferably less than half the total length of the stem, especially less than 35% and preferably roughly 20%. The end-side parts of the stems can be made in the most different ways, for example by mechanical cutting, brushing, whipping, water jet cutting, laser cutting, by rupturing as a result of brief strong energy feed, by chemical etching, or the like.

The adhesion closure elements can also be made such that the ends of the stems on the end surface pointed toward the surface of the carrier means have a flat or even slightly convex arch, especially the end surface opposite the following area of the stems being flared. The throat-like flaring of the ends of the stems can define a type of predetermined kinking point which enables detachment of the adhesion closure elements from the carrier means with lower forces. The end surfaces of the stems interact with the surface of the carrier means by van der Waals forces. Suitable plastic materials for these adhesion closure elements are inorganic and organic elastomers,

especially polyvinyl siloxane, and addition-crosslinking silicone elastomers, also in the form of binary systems as acrylates. The use of rubber materials is also possible.

The production process can be made especially favorable when the plastic material used at the time is thixotropic. Thixotropic behavior in the sense of the invention means reducing the structural thickness during the shear loading phase and its more or less rapid but complete re-establishment during the subsequent resting phase. This breakdown/build-up cycle is a completely reversible process and thixotropic behavior can be defined as a time-dependent behavior. Furthermore, plastic materials have proven especially advantageous in which a viscosity of 7000 to 15000 mPas measured with a rotary viscosimeter is sufficient, but preferably has a value of roughly 10000 mPas at a shear rate of 10 1/sec. In the sense of a self-cleaning surface it has moreover proven to be advantageous to use plastic materials with a contact angle which has at least a value of greater than 60° due to their surface energy for wetting with water. Under certain circumstances this surface energy can also be further changed by subsequent coating processes.

In one special embodiment of the invention the adhesion closure elements in any case are produced partially without molding tools. The pertinent process is described in DE 100 65 819 C1 and DE 101 06 705 C1. In this connection plastic material is deposited by means of at least one application device in successively released drops, and the deposition locations of the drops can be chosen to be three-dimensional with respect to the shape of the adhesion closure elements to be formed. In this way hook elements, mushroom elements, loop elements and the like can be produced with great latitude of shape, for example in the manner of an inkjet printing process.

Preferably the first flat substrate is produced from a plastic, especially from a thermoplastic. Alternatively the first flat substrate can also be produced from a duroplastic, especially in the case of adhesion closure elements which are produced without molding tools. The adhesion closure elements consist preferably of the same material as the first flat substrate. Basically especially

polyethylenes and polypropylenes are possible. Moreover a plastic material can be selected which is chosen from the group of acrylates such as polymethacrylates, polyethylene, polypropylene, polyoxymethylene, polyvinylidene fluoride, polymethylpentene, polyethylene chlorotrifluoroethylene, polyvinyl fluoride, polyethylene oxide, polyethylene terephthalate, polybutylene terephthalate, nylon 6, nylon 66, and polybutene.

Preferably the first flat substrate is flexible. In this way flexible, foldable or rollable display devices can be implemented. In this way the display device can be fixed on carrier means of almost any shape.

Preferably the triggerable pixels and/or at least some of the trigger electronics are located on the first flat substrate. The trigger electronics can have especially one active switching device, especially a switching transistor, per pixel. Depending on the technology selected for the pixels, for example liquid crystals, electronic inks, or electroluminescent elements, in any case part of the trigger electronics and/or of the pixels can be produced by common process steps, especially by the process steps known from thick film technology or thin film technology, such as for example vapor-deposition, cathode sputtering, precipitation from the gaseous phase, photolithographic structuring and the like.

The triggerable pixels and/or at least part of the trigger electronics can be located on a second surface of the first flat substrate, especially opposite the first surface. The pixels and trigger electronics can be located next to one another or on top of one another. The emission direction or reflection direction can be dictated by the corresponding reflection layers or cover layers. Basically the display device can be made as a transmitted light display device, reflection display device, or self-luminous display device. For example there can be a flat illuminant in the manner of the background illumination of a LCD. The flat illuminant can be made integrally with the first flat substrate, in particular the luminous layer can be applied flat on one surface of the flat substrate.

The pixels can be produced on the second flat substrate, especially separately from the first flat substrate with its adhesion closure elements. In this case the partially or completely produced first and second substrates can be joined to one another, in particular the second flat substrate can be laminated to the first flat substrate. Alternatively, the pixels can also be applied directly to the first flat substrate, preferably after the adhesion closure elements are already located on its back. In this case the adhesion closure elements can be used to fix the substrate during the pixel production process. Depending on the technology of producing the pixels it is also possible, in an intermediate stage or after completion of production of the pixels, to apply the adhesion closure elements to the first flat substrate, for example by shaping the surface of the first flat substrate or by producing the adhesion closure elements without molding tools, as is described above.

In one special embodiment of the invention a flat illuminant is applied to the first flat substrate which preferably already has the adhesion closure elements, first of all in thick film or thin film technology. Separately from this, the actual display device with the pixels and optionally also the trigger electronics are applied to the second flat substrate, and electrical connections can also be produced between the trigger electronics on the second substrate and the illuminant on the first substrate.

Other advantages, features and details of the invention will become apparent from the dependent claims and the following description in which with reference to the drawings several embodiments are described in particular. In doing so the features mentioned in the claims and in the description can be important to the invention individually for themselves or in any combination.
For the sake of clarity the illustrations are not drawn to scale.

FIG. 1 schematically shows a cross section through a first embodiment of the display device,

FIG. 2 schematically shows a cross section through a second embodiment of the display device,

FIG. 3 schematically shows a cross section through a third embodiment of the display device, and

FIG. 4 shows a cross section through the adhesion closure element of FIG. 3.

FIG. 1 schematically shows a cross section through a first exemplary embodiment of the display device 1 as claimed in the invention, having a plurality of pixels 2 for display of static and motion pictures, alphanumeric characters or the like. The pixels 2 can also be triggered by means of trigger electronics which are not detailed in FIG. 1 individually or in groups, especially in the conventional form by way of rows and columns. Overall for example a matrix of 640 x 480 pixels can be triggered, and for the case of a colored display each pixel can be formed from three pixel elements, for example one pixel element each for red, green and blue. The adhesion closure elements 5 protrude from a first flat substrate 3 from a first surface 4 at least in areas, preferably over the entire surface. These adhesion closure elements 5 can be formed integrally by the first substrate 3 and can be produced for example according to the process described in DE 196 46 318 A1.

A carrier means which can be a frame, the surface of a housing or also an article of textile clothing, for detachably securing the display device 1 likewise has adhesion closure elements 6 which interact with the adhesion closure elements 5 of the first flat substrate 3, especially can be interlocked with them. In this illustrated exemplary embodiment the adhesion closure elements 6 of the carrier means are made identically to the adhesion closure elements 5 of the first flat substrate 3. In particular, the adhesion closure elements 6 are made integrally with a support according to DE 196 46 318 A1 in the form of a second flat substrate 7. Alternatively to the illustrated exemplary

embodiment, the adhesion closure elements 5, 6 of the first flat substrate 3 and/or the carrier means can also be made hook-shaped, loop-shaped or pile-like. The adhesion closure elements 5 of the first flat substrate 3 can also be interlocked with the texture of an article of textile clothing, furniture upholstery, a wall covering, or the like.

On the side opposite the first surface 4 structural layers are applied to the first flat substrate 3 in thick film or thin film technology, from which layers the pixels 2 are produced. In particular, first electrical printed conductors 9 which form an electrode for the pixels 2, for example the cathode, are applied to the second surface 8. Furthermore, a layer 11 which emits light 10 when energy is supplied and which can also be a polymer layer can be applied to the cathode. These light-emitting polymer layers are known for example from PHILIPS product information: "Polymer light-emitting diodes". At the top a charge carrier-transporting layer 12 is applied which is covered by a transparent electrically conductive electrode 13, especially an anode.

When a voltage is applied between the first printed conductor 9 and the electrode 13, light 10 is emitted. The layers necessary for producing the pixels 2 can be produced for example by spin coating or by other processes known from thick and thin film technology with subsequent structuring, or also already structured using screen printing processes or printing heads, as are known from inkjet technology.

The first embodiment shown in FIG. 1 is a self-luminous display device 1. The light 10 can fundamentally be emitted all around or only in certain definable directions by cover layers or reflection layers. In particular it is fundamentally also possible to emit light 10 also or exclusively via the first surface 4 of the display device 1 on which the adhesion closure elements 5 are located.

FIG. 2 shows a second embodiment of a display device 101 as claimed in the invention. The first flat substrate 103 has adhesion closure elements 105 which protrude from the first surface 104

and which form a plurality of individual fibers 115 on their free end. Based on the selected material for the adhesion closure elements 105 chemical binding forces occur on the individual fibers 115, especially dipole binding forces or van be Waals forces, with which the display device 110 can also be attached to carrier means which do not have any special surface structure, especially do not themselves form mechanical adhesion closure elements.

On the opposite surface, structures are applied to the first flat substrate 103 by which electrical switching functions can be accomplished, especially field effect transistors. The first electrical printed conductor 109 forms a control electrode, especially the gate electrode of a polymer field effect transistor. Over it there is an insulating layer 116 which forms the gate insulation. On it are source electrodes 117 and acceptor electrodes 118, especially source and drain electrode of the field effect transistor. The current flow between the source electrode 117 and the acceptor electrode 118 can be controlled via the potential on the first printed conductor 109. The pertinent output electrode 119 is switched to a definable potential according to the operating state.

The actual light-controlling or light-emitted layer, for example also the arrangement of the light emitting diodes shown in the first exemplary embodiment, an arrangement of liquid crystals which represent the individual pixels by a cell-like arrangement, or other display means, can now be applied to the first flat substrate 103.

In the second embodiment of FIG. 2 the pixels 102 are formed by so-called electronic ink. To do this, in a second flat substrate 123 in microcapsules 120 black and white particles 121, 122 are enclosed which can be moved under the influence of an electrical field within the microcapsule 120. The electrical field necessary to do this is produced by terminal electrodes 124, 125 which are provided in pairs for each pixel 102. By applying a corresponding potential to the terminal electrodes 124, 125 a definable distribution of black and white particles 121, 122 arises within the

microcapsule 120, which yield a different visual appearance when light shines through or is reflected.

In the illustrated exemplary embodiment the first flat substrate 103 and the second flat substrate 123 can be produced separately, and in a subsequent process the first flat substrate 103 is permanently connected to the second flat substrate 123, for example laminated, pressed, cemented, fused or the like. In this mechanical connection the required electrical connections can also be produced between the first flat substrate 103 which has at least parts of the trigger electronics, and the second flat substrate 123, for example by bringing the output electrodes 119 into contact with the terminal electrodes 124, 125.

FIG. 3 shows another embodiment of the adhesion closure elements 205 used as claimed in the invention in a perspective view of the first surface 204 of the first flat carrier 207. FIG. 4 shows a cross section through an adhesion closure element 205.

The height 226 of the adhesion closure elements 205 from the surface 204 to the preferably plane end surface 214 is between 20 and 500 μm, especially between 50 and 200 μm, preferably roughly 100 μm. The extension 227 of the plane end surface 214 parallel to the surface 204 is between 10 and 250 μm, especially between 25 and 100 μm, preferably roughly 50 to 60 μm. Spaced between 5 and 30% of the height 226 of the end surface 214, especially between 10 and 20%, preferably roughly 15%, the adhesion closure element 205 by a cross section reduced for example by roughly 10 to 40%, especially roughly 20 to 25%, forms a type of predetermined kinking point 228 at which the head part with the end surface 214 can bend when the adhesion closure element 205 is detached and thus can facilitate detachment from the surface of the carrier means. The distances between adjacent adhesion closure elements 205 are preferably less than the extension 227 of the plane end surface 214, preferably they are between 50 and 80% of the extension 227.

The adhesion closure elements 205 are preferably symmetrical to the axis 229 of symmetry, especially rotationally symmetrical. Both the head cross sections as well as the stem cross sections can be square, especially can be provided with a hexagonal cross sectional shape, and the aspect ratio of an adhesion closure element 205 is preferably between 1:1.5 and 1:5.